

What is claimed is:

1. A direct optical amplifier for establishing a correlation between the average level of a main signal having a plurality of channels and the level of a pilot tone signal for controlling the average level of said main  
5 signal to a desired level, said direct optical amplifier comprising:

optical amplification means for amplifying the main signal and the pilot tone signal;

pumping light generation means for generating  
10 pumping light that optically pumps said optical amplification means;

wavelength analysis means for analyzing the spectral intensity of an optical transmission signal that includes the main signal and the pilot tone signal and extracting  
15 the level of the pilot tone signal and the average level of the main signal from which a noise component has been eliminated;

pilot tone signal monitor means for monitoring the level of the pilot tone signal that has been extracted by  
20 said wavelength analysis means;

main signal monitor means for monitoring the average level of the main signal from which a noise component has been eliminated and which has been extracted by said wavelength analysis means;

25 processing means for establishing a correlation

between the level of the pilot tone signal that is monitored by said pilot tone signal monitor means and the average level of the main signal from which the noise component has been eliminated and which is monitored by  
30 said main signal monitor means, determining the level of the pilot tone signal that corresponds to a desired average level of the main signal from which the noise component has been eliminated; and taking this pilot tone signal level as a target level; and  
35 pumping light control means for controlling the intensity of the pumping light that is generated by said pumping light generation means and adjusting the amplification factor of said optical amplification means such that the level of the pilot tone signal that is  
40 monitored by said pilot tone signal monitor means becomes said target level that is determined at said processing means.

2. A direct optical amplifier for establishing a correlation between the average level of a main signal having a plurality of channels and the level of a pilot tone signal for controlling the average level of said main  
5 signal to a desired level, said direct optical amplifier comprising:

optical amplification means for amplifying the main signal and the pilot tone signal;

pumping light generation means for generating  
10 pumping light that optically pumps said optical  
amplification means;

wavelength analysis means for analyzing the spectral  
intensity of an optical transmission signal that includes  
the main signal and the pilot tone signal and extracting  
15 the level of the pilot tone signal, the average level of  
the main signal from which a noise component has been  
eliminated, and the level of amplified spontaneous  
emission light that is contained in the main signal;

pilot tone signal monitor means for monitoring the  
20 level of the pilot tone signal that has been extracted by  
said wavelength analysis means;

main signal monitor means for monitoring the average  
level of the main signal from which a noise component has  
been eliminated and which has been extracted by said  
25 wavelength analysis means;

ASE monitor means for monitoring the level of the  
amplified spontaneous emission light that is contained in  
the main signal and that has been extracted by said  
wavelength analysis means;

30 processing means for establishing a correlation  
between the level of the pilot tone signal that is  
monitored by said pilot tone signal monitor means and a  
level that is obtained by subtracting the level of the  
amplified spontaneous emission light that is contained in

35 the main signal and that is monitored by said ASE monitor  
means from the average level of the main signal from which  
a noise component has been eliminated and which is  
monitored by said main signal monitor means, determining  
the level of the pilot tone signal that corresponds to a  
40 desired average level of the main signal from which a  
noise component and an amplified spontaneous emission  
light component have been eliminated; and taking this  
pilot tone signal level as a target level; and  
pumping light control means for controlling the  
45 intensity of the pumping light that is generated by said  
pumping light generation means and adjusting the  
amplification factor of said optical amplification means  
such that the level of the pilot tone signal that is  
monitored by said pilot tone signal monitor means becomes  
50 said target level that is determined by said processing  
means.

3. A direct optical amplifier for establishing a  
correlation between the average level of a main signal  
having a plurality of channels and the level of a pilot  
tone signal for controlling the average level of said main  
5 signal to a desired level, said direct optical amplifier  
comprising:

optical amplification means for amplifying the main  
signal and the pilot tone signal;

pumping light generation means for generating  
10 pumping light that optically pumps said optical  
amplification means;

wavelength analysis means for analyzing the spectral  
intensity of an optical transmission signal that includes  
the main signal and the pilot tone signal and extracting  
15 the level of the pilot tone signal and the average level  
of the main signal from which a noise component has been  
eliminated;

pilot tone signal monitor means for monitoring the  
level of the pilot tone signal that has been extracted by  
20 said wavelength analysis means;

main signal monitor means for monitoring the average  
level of the main signal from which a noise component has  
been eliminated and which has been extracted by said  
wavelength analysis means;

25 ASE data memory means for storing the level of  
amplified spontaneous emission light that is contained in  
the main signal and that has been measured in advance for  
each number of channels of the main signal and supplying  
as output the value of the level of the amplified  
30 spontaneous emission light that corresponds to the number  
of channels that is supplied as input;

processing means for establishing a correlation  
between the level of the pilot tone signal that is  
monitored by said pilot tone signal monitor means and a

35 level that is obtained by subtracting the level of the  
amplified spontaneous emission light that is contained in  
the main signal and that has been supplied as output by  
said ASE data memory means from the average level of the  
main signal from which a noise component has been  
40 eliminated and which is monitored by said main signal  
monitor means, determining the level of the pilot tone  
signal that corresponds to a desired average level of the  
main signal from which a noise component and an amplified  
spontaneous emission light component have been eliminated;  
45 and taking this pilot tone signal level as a target level;  
and

pumping light control means for controlling the  
intensity of the pumping light that is generated by said  
pumping light generation means and adjusting the  
50 amplification factor of said optical amplification means  
such that the level of the pilot tone signal that is  
monitored by said pilot tone signal monitor means becomes  
said target level that is determined by said processing  
means.

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4. A direct optical amplifier for establishing a  
correlation between the average level of a main signal  
having a plurality of channels and the level of a pilot  
tone signal for controlling the average level of said main  
5 signal to a level in a desired range, said direct optical

amplifier comprising:

optical amplification means for amplifying the main signal and the pilot tone signal;

pumping light generation means for generating  
10 pumping light that optically pumps said optical amplification means;

wavelength analysis means for analyzing the spectral intensity of an optical transmission signal that includes the main signal and the pilot tone signal and extracting  
15 the level of the pilot tone signal and the average level of the main signal from which a noise component has been eliminated;

pilot tone signal monitor means for monitoring the level of the pilot tone signal that has been extracted by  
20 said wavelength analysis means;

main signal monitor means for monitoring the average level of the main signal from which the noise component has been eliminated and which has been extracted by said wavelength analysis means;

25 main signal limit memory means for storing the maximum levels and minimum levels of the average levels of the main signal that have been determined in advance for each number of channels of the main signal, and for supplying as output the values of the maximum level and  
30 minimum level that correspond to the number of channels that is supplied as input;

processing means for establishing a correlation  
between the level of the pilot tone signal that is  
monitored by said pilot tone signal monitor means and the  
35 average level of the main signal from which the noise  
component has been eliminated and which is monitored by  
said main signal monitor means; determining the level of  
the pilot tone signal that corresponds to the average  
level of the main signal from which the noise component  
40 has been eliminated and which is monitored by said main  
signal monitor means and making this level of the pilot  
tone signal the target level when the average level of the  
main signal from which the noise component has been  
eliminated is between said maximum level and said minimum  
45 level that have been supplied as output by said main  
signal limit memory means; determining the level of the  
pilot tone signal that corresponds to said maximum level  
and making this level of the pilot tone signal the target  
level when the average level of the main signal from which  
50 the noise component has been eliminated exceeds said  
maximum level that has been supplied as output by said  
main signal limit memory means; and determining the level  
of the pilot tone signal that corresponds to said minimum  
level and making this level of the pilot tone signal the  
55 target level when the average level of the main signal  
from which the noise component has been eliminated is  
below said minimum level that has been supplied as output



by said main signal limit memory means; and

60       pumping light control means for controlling the  
intensity of the pumping light that is generated by said  
pumping light generation means and adjusting the  
amplification factor of said optical amplification means  
such that the level of the pilot tone signal that is  
monitored by said pilot tone signal monitor means becomes  
65       said target level that is determined by said processing  
means.